

## ALGORITHM OF REMOTE MONITORING OF CLINICAL TERMS USING MOBILE PHONE

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### ABSTRACT

In today's life the health monitoring is becoming important. As technology has become more advanced the persons are becoming very busy. The problems like high blood pressure, heart attacks are increased and getting time to go for regular health checkup has become difficult. Hence with in home the facility of getting health checked is becoming need of world. The aim of this project is to use embedded information and mobile communication technologies for health care.

Also patient living in a remote area might seek medical advice from a specialist far away. Remote health monitoring devices fill this gap. These devices eliminate the need for the patient to visit a doctor. It allows remote collection of patient data through a SIM 300 modem. These devices also allow the specialist to communicate feedback to the patient which is remotely, using SMS alerts. In this system clinical data of patient is taken and sent to a android O.S based mobile for processing and may trigger necessary SMS action.

**KEYWORDS:** Android, ARM processor, Eclipse SDK, Keil 4, SIM 300 Modem

### INTRODUCTION

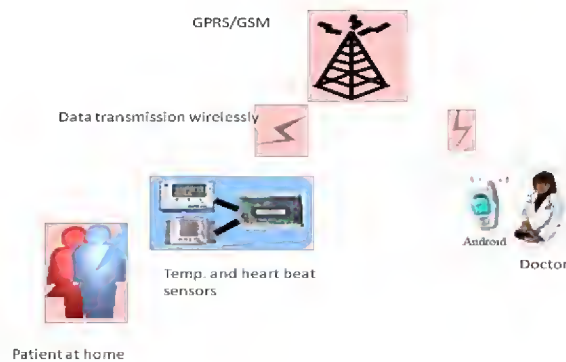
Heart attack is the leading causes of hospitalization for the elderly. The chances of surviving after heart attack are much greater if the senior gets help within time [1]. The elderly or people with disabilities want to remain in their homes even when their health condition has been getting worse. Hence health monitoring using wearable sensor and mobile phones has become need of today [2]. Depending on the situation the smart phone can automatically alert regarding health for patients and aged people. Taking clinical data of a user and sending it to an Android based mobile for processing and it will trigger necessary actions. The process can take place anywhere, anytime also gives great freedom to system users. Figure 1.shows complete architecture of system .Android operating system is an open platform and hence the cost of the mobile monitoring system becomes less [3].

### CHOICE OF HARDWARE

#### ARM controller

The LPC2148 microcontrollers are based on a 16-bit/32-bit ARM7TDMI-S CPU with real-time emulation and embedded trace.ARM controller is embedded high-speed flash memory ranging from 32 kB to 512 kB. Architecture Enable 32-bit code execution at the maximum clock rate. For critical code size applications, the alternative 16-bit Thumb mode reduces code by more than 30% with high performance. Serial communications interfaces ranging from a USB 2.0 Full-speed device, multiple UARTs, SPI, I<sup>2</sup>C-bus and on-chip SRAM of 8 kB up to 40 kB. Various 32-bit timers, single or dual 10-bit ADC(s), 10-bit DAC, PWM channels and 45 fast GPIO lines with up to nine edge or level sensitive external

interrupt pins make these microcontrollers suitable for industrial control and medical systems. It is having load/store architecture and simple addressing schemes which simplify instruction decoding and operand fetches [11]. In this research, the GPIO ports are used to control the physiological sensing device, and the UART ports are used to connect the GSM/GPRS and GPS modules.



**Figure 1: Architecture of Platform System**

### Body Temperature

Body temperature is a measure of the body's ability to generate heat. The body is very good at keeping its temperature within a safe range in spite of large variations in temperatures outside the body. Normal human body temperature depends upon the place in the body at which the measurement is made also the time of day and level of activity of the person. Different parts of the body have different temperatures oral measurements are somewhat higher than skin temperature. The commonly accepted body temperature is  $37.0^{\circ}\text{C}$ . The LM35 series are precision integrated-circuit output is linearly proportional to the Celsius temperature. The scale factor is  $+10.0\text{mv}/^{\circ}\text{C}$ . The voltage value is sent to ARM processor via ADC. The temperature is determined by looking up the temperature corresponding to that specific voltage in the lookup table written in the program of ARM controller.

### Heart Beat

A normal resting heart rate for adult's ranges from 60 to 100 beats a minute. There are many ways in which the Heart Rate speeds up or slows down. In this heart beat measurement unit the sensor consists of a super bright red LED and light detector. The LED used is super bright as the maximum light must pass spread in finger and detected by detector. When the heart pumps a pulse of blood through the blood vessels, the finger becomes slightly more opaque and so less light reached the detector. With each heart pulse the detector signal varies. This variation is converted to electrical pulse. This signal is amplified and triggered through an amplifier which outputs  $+5\text{V}$  logic level signal.



**Figure 2: Heart Beat Sensor**

When a finger is put in the sensor, it displays the beats per minute (BPM) rate. If the pulse rate is 60 BPM (beats per minute) there will be a pulse every second. The duration of one heart beat will be one seconds or  $1000 \times 1\text{ms}$ . Dividing 60,000 by 1000 gives the correct result of 60.

## LCD

Liquid Crystal Displays has combine properties of both liquids and crystals. An LCD consists of two glass panels, with the liquid crystal materials sand witched between them LCD are more reliable and energy efficient. Its low power energy consumption makes it to be used in battery powered electronic devices. The Liquid Crystal Display is intrinsically a passive device. The managing and control of the data to be displayed is performed by programs commonly denoted as LCD drivers. The toxic level of carbon monoxide and the oxygen level inside the cabin will be displayed each and every second in the LCD. Here LCD display of 2x16 is used to display the message while input data is taken and display the message of received SMS from doctor.

## GSM Modem

SIM 300 is GSM/GPRS Wireless Module.SIM 300 GSM Modem can accept any GSM network operator SIM card and act just like a mobile phone with its own unique phone number. Advantage of using this modem is that we can use its RS232 port to communicate and develop embedded applications. Applications like SMS Control, data transfer, remote control and logging can be developed easily. The modem can either be connected to PC serial port directly or to any microcontroller. It is used to send and receive SMS.

## CHOICE OF MOBILE OPERATING SYSTEM

### Android

Android is a software development platform for mobile devices built upon a foundation of the Linux kernel. It includes library, virtual machine, application framework and key applications. The Android SDK provides the tools and APIs necessary for developing applications on the Android platform using the Java programming language [12].

**Table 1: Requirements of Android**

|                      | Android                   |
|----------------------|---------------------------|
| Hardware Requirement | 200 MHz Online processor  |
|                      | 32 MB RAM and 32 MB Flash |
| Software Requirement | JDK 5 or JDK 6            |
| Costs                | Free                      |
| Native development   | Yes                       |
| Language             | Java                      |
| Digital certificate  | No                        |

There are many features provided by Android platform for the Android application developer. The UI subsystem includes windows, views lists and edit boxes, widgets, and an integrated browser built upon Web Kit. The connectivity options include wireless networks like Bluetooth and Wi-Fi and mobile networks like GPRS, EDGE and 3G. It provides a 2D and 3D graphics library and an embedded Sqlite database. The camera, Google Maps, GPS and accelerometers are also available in the Android. Android applications do not have a single entry point for everything in the application i e no main () function. In android, broadcast receiver is a component that does nothing but receives and reacts to broadcast announcements. For example, a broadcast receiver is used to receive or send or reply a text message [10].

The smart-phone used is having Android 2.3 Micro max's Ninja. The application software developed using Android O.S Eclipse software and java programming. The software decodes received each SMS and extracts originating mobile number, and the transmitted patient's temperature heart beat rate. The software converts the data in the message from binary to ASCII and displays the contents of the message .After comparing the data with reference level data of temperature and heart beat back SMS is send to user regarding health is OK or Not. Android application is responsible for analysing the data and triggering actions deemed appropriate.

## **CHOICE OF DEVELOPMENT ENVIRONMENTS**

### **Softwares**

#### **Keil $\mu$ Vision4**

Keil  $\mu$ Vision 4 is an IDE (Integrated Development Environment) that helps to write, compile, and debug embedded programs. It encapsulates the following component,  $\mu$ Vision4 compiles, assembles and links the files in written project. The Keil  $\mu$ Vision 4 has C compiler for the ARM 7 is used to solve the complex problems facing embedded software developers. It provides more features than any other 8051 C compiler available today. The ARM controller applications that are written in C and once complied using the  $\mu$ vision 4 compiler have the efficiency and speed of the assembly language. This Keil  $\mu$ Vision 4 compiler generates fast compact codes for the ARM 7 and its derivatives. It supports a number of C language extensions that have been added to support ARM architecture like data types, pointers, memory types, Interrupts.

#### **Flash Magic**

Flash magic is downloading software. It supports for Philips controllers. In this the file converted in .hex format is browsed and downloaded in hardware.

#### **Eclipse SDK**

Eclipse is an open source community, whose projects are focused on building an open development platform comprised of extensible frameworks, tools and runtimes for building, deploying and managing software across the lifecycle [9]. The Eclipse SDK consists of the Eclipse Platform, Java development tools and the Plug-in Development Environment. Using eclipse the application file written in java language is converted to apk file. This file is used in mobile and installed.

### **Programming Languages**

#### **Embedded C Language for ARM Controller**

Embedded C is uses part of the C language. It aims to provide portability and access to common performance-increasing features of processors used in domain of the DSP and embedded processing. The embedded C specification for fixed-point, named address spaces and named register gives the programmers direct access to the features in the target processor there by significantly improving the performance of the applications. The hardware I/O extension is a portability feature of Embedded C. Its goal is to allow easy porting of device-driver code.

#### **Java Language for Application on Android O.S**

Java is used in a wide variety o f computing plat forms from embedded devices and mobile phones on the low end, to enterprise servers and supercomputers on the high end.

## TESTING

### Testing of SIM 300

SIM 300 modem is tested by using hyper terminal facility on windows XP. It is connected to PC via RS 232 cable. And using AT commands the hardware is tested.

The following procedure is used to test sending SMS in text Mode:

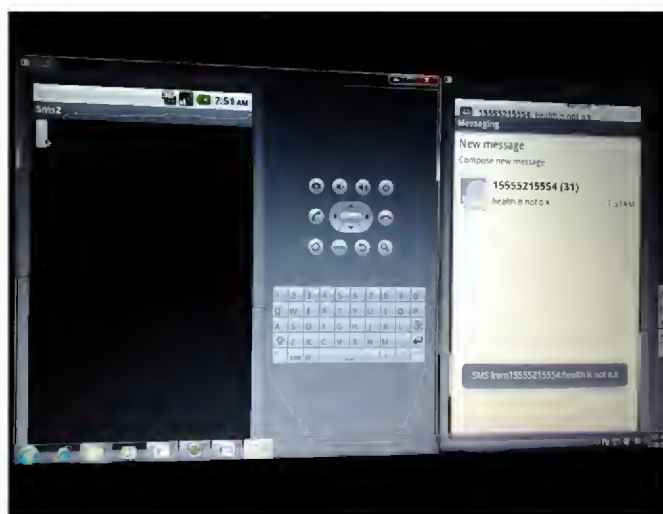
AT+CMGF=1 press enter. Expected result is OK. AT+CMGS="mobile number" press enter

Once the AT commands is given ' >' prompt gets displayed on the screen.

The message to send is typed. After this "ctrl + Z" is pressed to send the SMS.

If the SMS is sent successfully "OK" gets displayed along with the message number.

### Testing of Android SMS Program



**Figure 3: Output on AVD of Eclipse**

Figure 3 shows the output of SMS sending on AVD from 5554 to 5556.

## RESULTS

The implementation of remote health monitoring using android O.S based mobile is done successfully. The data on LCD display shows that health of patient is O.K. This message shown in Figure 4 is for the reading of Heart beat= 150BPM and temperature =37°C which is sent through SMS to android O.S based mobile. In the android based mobile, SMS data is compared with reference level of heart beat and temperature. And then back SMS is sent to SIM 300. This message is displayed on LCD display.





**Figure 4: Working Hardware**

## QUALITY OF SERVICE

### Patient Usability

The system is easy for patients to use. It requires minimal training and minimal maintenance. It minimizes power consumption to avoid the inconvenience of recharging. It is portable so that patients can take the system anywhere they go.

**Reliability:** The system collects and stores patient data, even in the face of network failures.

**Extensibility:** The system extends to a broad range of home monitoring devices by using a SMS sending and receiving.

**A financial resource:** The cost per patient is less also maintenance of system is minimal.

## CONCLUSIONS

This system allows analysis of clinical data of patient, sending it to doctor. Here the heart beat and temperature of patient is remotely monitored. Patients can be detected from home and also in critical situations this system becomes important. This system permits patients great freedom and gives them confidence that medical services can be delivered in time at right spot. It is easy to use and provides accurate measurements in low cost.

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